IN THE CLAIMS

Listing of Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Claim 1. (currently amended) Apparatus for processing data for controlling a pressure to be applied to contact areas of a wafer and a polishing pad during a step in chemical mechanical polishing operations, the apparatus comprising:

a first processor programmed to provide pressure data representing the pressure to be applied to the contact areas during a polishing step; and

a second processor programmed to process data representing relative movement between the wafer and the pad in overlapped contacting positions for providing area data representing a value of the contact areas [area] between the wafer and the pad in the overlapped positions;

the second processor being further programmed to process the area data and the pressure data for providing force data representing the force to be applied to the contact areas during the polishing step of the sequence.

Claim 2. (original) Apparatus as recited in claim 1, wherein the second processor has a processing capacity sufficient for real-time control of the pressure to be applied to the contact areas of the wafer and of the polishing pad during the chemical mechanical polishing operations, the sufficiency of the processing capacity being determined according to values of variations in the pressure, the time rate of change of the pressure, the frequency of the relative movement between the wafer and the pad into the overlapped positions, the rate of the

relative movement, and processing points describing non-time-related actions during the chemical mechanical polishing operations.

Claim 3. (original) Apparatus as recited in claim 1, wherein the second processor is programmed to only process the data representing the relative movement between the wafer and the pad in the overlapped contacting positions for providing the area data representing the value of the contact area between the wafer and the pad in the overlapped positions, and the area data, and the pressure data.

Claim 4. (original) Apparatus as recited in claim 1, wherein each of the wafer and the pad is configured as a disk with the respective contact areas defined in terms of the radius of a circle, and wherein:

the programming of the second processor defines possible overlapped contact areas of the circles of each of the wafer and the pad in terms of only one variable, the variable being the relative position of the wafer and the pad; and

the programming of the second processor further defining the force in terms of only data representing the value of the contact areas and of the pressure.

Claim 5. (original) Apparatus as recited in claim 1, wherein there is a sequence of the data representing the relative movement between the wafer and the pad into successive overlapped positions, and wherein there is a pressure data item corresponding to each movement data item, and wherein:

the first processor is programmed to process each sequential item of movement data;

the first processor is programmed to input to the second processor one relative movement item of data at a time, with the one item being input with all of the items of pressure data corresponding to the one relative movement item; and

the second processor is programmed to simultaneously process the one item of movement data and the corresponding items of pressure data.

Claim 6. (currently amended) Apparatus for controlling a first pressure to be applied to first contact areas of a wafer and a polishing pad in chemical mechanical polishing operations, the pressure being applied according to force data specifying the value of forces to be applied to first contact areas, the apparatus comprising:

a drive system configured to cause relative movement between the wafer and the pad into overlapped positions;

a central processor for processing data to specify the chemical mechanical polishing operations, the data including a command to the drive system to cause the relative movement, the data further representing the pressure to be applied to the first contact areas of the wafer and the polishing pad;

a feedback circuit for providing output signals representing increments of the relative movement; and

a force control processor separate from the central processor, the force control processor [controller] being responsive to both the pressure data and [to] the output signals representing [the] actual values of the relative movement, the force control processor [controller] successively processing a contact area program and a force program to provide force data representing the force to be applied to one of the first contact areas of the wafer and the pad.

Claim 7. (currently amended) Apparatus as recited in claim 6, wherein the force control processor provides the force data in two stages, a first stage being in response to one of the output signals [signal] to provide area data representing a value of the contact areas, a second of the stages being in response to the pressure data and to the [contact] area data to provide the force data.

Claim 8. (original) Apparatus as recited in claim 6, further comprising:

a carrier for the wafer, the carrier including a linear bearing assembly resisting a tendency of the wafer to tilt in response to the force; the assembly further including a sensor mounted on the linear bearing assembly in a position to sense the force on the contact area, the sensor providing an accurate indication of an amount of the force.

Claim 9. (currently amended) Apparatus as recited in claim 6, wherein [in which] a retainer ring is provided for orienting the wafer, wherein the apparatus further controls [controlling] a second pressure to be applied to second contact areas of the ring and the pad, wherein the relative movement causes [causing] relative movement of the ring and the pad, and wherein [the apparatus further comprising]:

the central processor further processes [processing] second pressure data representing a value of the second pressure; and

the force control processor is [being] further responsive to the second pressure data and to the output signals representing the relative movement of the wafer and the pad, the force control processor [controller] further successively processes [processing] the contact area program and the force program to provide second force data representing the force to be applied to the second contact areas of the ring and the pad.

Claim 10. (currently amended) Apparatus as recited in claim 6, wherein [in which] a pad conditioning puck is provided for conditioning the pad, wherein the apparatus further controls [controlling] a second pressure to be applied to second contact areas of the puck and the pad, wherein the relative movement causes [causing] relative movement of the puck and the pad, and wherein [the apparatus further comprising]:

the central processor further processes [processing] second pressure data representing a value of the second pressure; and

the force control processor is [being] further responsive to the second pressure data and to the output signals representing the relative movement of the wafer and the pad, the force control processor [controller] further successively processes [processing] the contact area program and the force program to provide second force data representing the force to be applied to the second contact areas of the puck and the pad.

Claim 11. (currently amended) Apparatus for maintaining a constant pressure to be applied to respective contact areas of a wafer and of a polishing pad in chemical mechanical polishing operations, the apparatus comprising:

a drive for causing relative movement between the wafer and the pad into a plurality of different overlapped positions [,] ;

a force application system for urging the wafer and the pad against each other so that in each of the different overlapped [overlap] positions the respective contact areas are in contact and have different values, the system being capable of providing different forces for the urging;

a feedback circuit for providing first and second output signals representing respective first and second increments of the relative movement, the first and second increments being at spaced first and second times;

a central processor programmed for computing first position data in response to the first output signal, the first position data representing the actual relative movement at the first time, the central processor being further programmed for computing second position data in response to the second output signal, the second position data representing the actual relative movement at the

second time, the central processor being further programmed for computing pressure data representing the constant pressure to be maintained; and

a force control processor [controller] separate from the central processor, the force control processor [controller] being programmed for converting the first position data to first area data representing the value of a [the] first of the contact areas [area] at the first time, the force control processor [controller] being further programmed to process the first area data and the pressure data to output first force data representing a first force to be applied to the first contact area at the first time;

the force application system being responsive to the first force data for urging the wafer and the pad against each other with the first force to provide the constant pressure on the first contact area at the first time;

the force control processor [controller] being further programmed for converting the second position data to second area data representing the value of a [the] second of the contact areas [area] at the second time, the force control processor [controller] being further programmed to process the second area data and the pressure data to output second force data representing a second force to be applied to the second contact area at the second time;

the force application system being responsive to the second force data for urging the wafer and the pad against each other with the second force to provide the constant pressure on the second contact area at the second [first] time.

Claim 12. (currently amended) A method of controlling a pressure to be applied to contact areas of a wafer and of a polishing pad in chemical mechanical polishing operations, the method [apparatus] comprising the operations of:

providing a first processor to input pressure data representing the pressure to be applied to the contact areas during a polishing step;

providing a dedicated processor other than the first processor to only process three types of data, one type of data being data representing relative movement between the wafer and the pad in overlapped contacting positions, the pressure data being the second type of data [pressure data];

by use of the dedicated processor, computing area data representing a value of the contact area between the wafer and the pad in the overlapped positions, the area data being the third type of data; and

by use of the dedicated processor, processing the area data and the pressure data to compute force data representing the force to be applied to the contact areas during the polishing step of the sequence.

Claim 13. (original) A method of determining a value of available processing capacity of a processor for processing data to control a pressure to be applied to contact areas of a wafer and of a polishing pad in chemical mechanical polishing operations, comprising the operations of:

characterizing steps of the chemical mechanical polishing operations according to the available processing capacity required for real-time processing of the step at a rate sufficient for controlling the pressure to be applied to the contact areas of the wafer and of the polishing pad during the chemical

mechanical polishing operations, the characterizing being with respect to at least one of the following characteristics of the steps:

values of variations in the pressure, or the time rate of change of the pressure, or the frequency of the relative movement between the wafer and the pad into the overlapped positions, or the rate of the relative movement; and

for each of the at least one characteristic, determining a value of the available processing capacity required for the real-time processing of the step data necessary to control the pressure to be applied to the contact areas of the wafer and of the polishing pad in the step of the chemical mechanical polishing operations.

Claim 14. (original) A method as recited in claim 13, wherein the processing is provided with an input of pressure data representing the pressure to be applied to the contact areas during a polishing step; and wherein the operation of determining a value is performed with respect to a dedicated processor that only processes three types of data, one type of the data being data representing relative movement between the wafer and the pad in overlapped contacting positions, the pressure data being the second type of data pressure data, and the third type of data being area data representing a value of the contact area between the wafer and the pad in the overlapped positions; and

wherein the operation of determining a value is further performed with respect to the dedicated processor computing the area data, and then processing the area data and the pressure data to compute force data representing

the force to be applied to the contact areas during the polishing step of the sequence.

Please add the following claims:

Claim 15. (New) A method according to claim 14, wherein:

the characterizing operation is performed with respect to at least two of the characteristics of the steps; and

the determining operation is performed for each of the at least two characteristics.

Claim 16. (New) A method according to claim 14, wherein:

the characterizing operation is performed with respect to at least three of the characteristics of the steps; and

the determining operation is performed for each of the at least three characteristics.

Claim 17. (New) A method according to claim 14, wherein:

the characterizing operation is performed with respect to the four characteristics of the steps; and

the determining operation is performed for each of the four characteristics.